Original article

Association between problematic behaviors and individual/environmental factors in difficult children

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Abstract

Background: Difficult children are ones whose behavior deviates from the norm, which manifests as restlessness, violence, and difficulty in separating from the mother. Such problematic behaviors usually exhaust their parents during child rearing. This study aimed to identify individual and environmental factors that influence children's problematic behavior, which could be helpful in supporting parents' child rearing.

Methods: Records of children's problematic behaviors and their individual or environmental information were collected from 8691 children at their 5-year-old health checks. Problematic behaviors were divided into three categories; anxious behaviors, developmental behaviors, and personal habits. Individual factors included sex, parental age, birth order, birth weight, and birth abnormalities. The environmental factors were mother's smoking during pregnancy or currently, partner's cooperation in child rearing, having someone to consult about child rearing, and television viewing time. Using logistic regression, we identified the association between such behaviors and aggravating factors.

Results: Problematic behavior was identified in 2.2%, 11.5%, and 16.1% of cases, respectively, with regard to anxious behaviors, developmental behaviors, and personal habits. The individual factors (including birth order and birth abnormality), and the environmental factors (including mothers currently smoking, lack of someone to consult about child rearing, and long television-watching time) were associated with the odd ratio of increased risk for some problematic behaviors.

Conclusion: Behaviors in difficult children are not influenced by individual factors but by several environmental factors. To reduce the parental child rearing burden, health providers should be aware of these aggravating factors.
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Keywords: Rearing child; Difficulty; Smoking; Behaviors; TV viewing

1. Introduction

Japan has ongoing mental and child health problems, such as s declining birthrate [1], increasing child poverty rate, and nuclear families, which result in child rearing

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difficulties. Those problems may cause parental concerns about their children's development; instability of the mother's mental health may lead to a chance of child abuse [2,3]. The first stage of Healthy Parents and Children 21 which aims to improve maternal and child health in Japan, has been implemented since 2001. The second stage was introduced in 2014. The prime aims with that campaign are to support parents who are encountering difficulties in raising children and take steps to prevent child abuse, beginning with pregnancy. Among others, child violence, restlessness, anxiety, restrictive diet, and personal habits, have been proposed as problematic behaviors for parents when raising children; individual and environmental factors affect such behaviors. These children who are presenting those problematic behaviors are called as "Difficult Children". It is known that individual factors, such as premature birth, low-birth-weight infants, and asphyxia often cause developmental and behavioral problems in children [4–7]; however, the environmental factors, such as parental smoking during pregnancy, are also related with behavioral problems, including hyperactivity and restlessness [8–12].

Child's problematic behaviors affects the maternal mental health and can result in depression and anxiety as well as poor, physical condition [13]. Stress coping in the parents' daily lives, partner support, cooperation of friends, and social support may help reduce maternal stress in childrearing [14]. It has also been found that greater maternal stress produces more emotional and behavioral problems among children.

Using health examination data for 8689 children, the present study aimed to identify the child individual factors and environmental factors associated with child problematic behaviors. The results of this investigation may help health providers in providing a supportive role for parents.

2. Material and methods

2.1. Data source

In Japan, health checks at the ages of 18 months and 3 years are required by the Maternal and Child Health Law. The main purpose of these infant health checks is to monitor healthy growth and to support parental concerns about their infants' growth and development. The health checks are at the government's expense; the participation rate in 2015 for the checks was 95.7% for infants aged 18 months and 94.3% for those aged 3 years [15]. Independently of local government budgeting, municipalities undertake health checks at the ages of 3–4 months and 9–10 months.

The Pediatric Association of Fukuoka District runs its own infant health check system: it covers health checks at the ages of 1 months, 3–4, 9–10, 12, and 18 months and at 2, 3, 4, 5, and 6 years. Upon payment of a fee, parents can have their children take part in the health checks.

In the present study, health check data from 8689 5-year-old preschool children were provided by the Pediatric Association of Fukuoka District System. Those preschool children were born in 2009 or 2010, and they underwent the 5-year-old health check in 2014 or 2015 at primary pediatric clinics. The population of Fukuoka city in 2014 (2015) was 1.4 million (1.4 million); the number of 5-year-old infants was 12,442 (12,232). The participation rate for the 5-year health check was estimated to be 36.5%.

2.2. Health check data

Mother of these preschool children applied for the health check for their 5-year-old and children and visited a primary pediatric clinic. In a health check questionnaire, their mother was asked to provide individual and environmental information, details of their children's development, vaccination history, accident history (e.g., injuries, burns, accidental ingestion), and indicate their concerns about their children's behavior.

Individual information included parental age at the time of the health check, child's sex, birth order, and birth details (weight, gestational week, birth abnormalities). Environmental information included parents' smoking habits during pregnancy, parents' current smoking habits, presence of someone to consult about child rearing, paternal cooperation in child rearing, and daily television-viewing time. Parental concerns for child behaviors included being afraid, violence, restlessness, rebellious behavior, restrictive diet, stereotypic behaviors, thumb sucking, nail biting, tics, masturbation, excretory problems, and difficulty in separating from the mother. Those items which were often consulted from parents were selected by a committee of Pediatric Association of Fukuoka District. After their mother completed the health questionnaire, their children were examined by a primary care physician for growth, development, and behavior. The physician made an assessment using information from both the health check questionnaire and the examination and offered counseling about parents' concerns.

2.3. Classification of child behaviors causing parental concern

From the parents' descriptions of their concerns about their children's behavior, we divided behavior into three categories; anxiety symptoms; development problems; and personal habits (Table 1). Anxious behaviors included being afraid and difficulty in being separated from the mother. Developmental behaviors

Table 1
Classification of child behaviors that caused parent concern

Anxious behavior	being afraid
	difficulty being separated from one's mother
Developmental behavior	violence
	restlessness
	rebellious behavior
	restrictive diet
	stereotypic behaviors
Personal habits	thumb sucking
	nail-biting
	tics
	masturbation

included violence, rebellious behavior, restlessness, restrictive diet, and stereotypic behaviors. Personal habits included thumb-sucking, nail-biting, tics, and masturbation. If a parent checked one of those symptoms, problems, or habits on the health check form, we regarded them as having concerns in that category.

2.4. Analysis

We excluded from the analysis the data from 116 children owing to the accidental inclusion of data from previous health checks. We determined the number of individual factors, environmental factors, and problematic behavior from the health check records. Using logistic regression analysis, we identified the relationship among individual factors, environmental factors, and categories of their problematic behavior. We also undertook multiple logistic analysis with all variables as explanatory variables. We observed no multicollinearity. We also analyzed the relationships among the above factors and child developmental behaviors. A p-value of 0.05 was set as the significant threshold for all statistical analysis.

2.5. Ethics

This study was approved by the ethical committee of Kurume University of Medicine (#19292).

3. Results

3.1. Numbers and frequency of individual and environmental factors

There was no gender difference among the 4298 boys and 4182 girls. The number (frequency) of the firstborn children was 4325 (51.0%). The numbers of children who were born as low-birth-weight babies (under 2500 g) or as preterm infants (under 37 weeks) were 809 (10%) and 485 (6.4%), respectively. In all, 549 (6.6%) children had some abnormalities at birth, such as neonatal asphyxia, jaundice, congenital heart disease,

and respiratory disorder. The numbers of father and mothers aged over 40 years were 3208 (41.6%) and 2387 (28.9%), respectively. Among fathers, those who smoked during the mother's pregnancy or were currently smokers were 3640 (44.7%) and 3172 (40.0%), respectively. The numbers of mothers who smoked during pregnancy or currently smoked were 388 (4.0%) and 832 (9.9%), respectively. In all, 204 (2.4%) and 424 (5.3%), respectively, mothers lacked someone to consult about child rearing or lacked paternal cooperation in that regard. In all, 4288 (51.3%) children watched television for over 2 h daily. Table 2 shows the numbers of individual and environmental factors s for the problematic behavior categories.

3.2. Relationship between individual and environmental factors and problematic behaviors categories

Table 3 presents the results of univariate and multivariate logistic regression analysis. In the multivariate logistic regression analysis after adjustment for confounding variables, many covariates for individual factors (excluding father's age) were significantly associated with some type of child problematic behavior. Being male was at increased risk of developmental behavior: odds ratio (OR), 1.83; 95% confidence interval (CI), 1.54–2.18); mother's age (<40 years) was at decreased risk of developmental behavior (OR, 0.71; 95% CI, 0.57–0.87). Birth order (firstborn child) showed an increased risk of all problematic behavior, including anxious behavior (OR, 1.64; 95% CI, 1.13–2.66), developmental behavior (OR, 1.70; 95% CI, 1.43–2.03), and personal habits (OR, 1.16; 95% CI, 1.01–1.34). By contrast, lack of birth abnormalities displayed a decreased risk for all three types of problematic behavior: anxious behavior (OR, 0.41; 95% CI, 0.24–0.71); developmental behavior (OR, 0.71; 95% CI, 0.52–0.90), and personal habits (OR, 0.73; 95% CI, 0.55–0.95). Regarding environmental factors, daily television-watching time of under 2 h showed decreased risk for three types of problematic behavior: anxious behavior (OR, 0.63; 95% CI, 0.47–0.99); developmental behavior (OR, 0.74; 95%

Table 2
Numbers and frequency of individual and environmental factors

		Anxious Behavior				Developmental Behavior				Personal habits			
		No		Yes		No		Yes		No		Yes	
Sex	boy	4202	(98%)	95	(2%)	3672	(86%)	625	(14%)	3573	(83%)	725	(17%)
	girl	4085	(98%)	97	(2%)	3831	(92%)	351	(8%)	3533	(85%)	649	(15%)
Father's age	<40 y.o	4111	(98%)	92	(2%)	4017	(89%)	485	(11%)	3750	(83%)	753	(17%)
	≥40 y.o	3140	(98%)	68	(2%)	2866	(89%)	342	(11%)	2742	(86%)	466	(14%)
Mother's age	<40 y.o	5726	(98%)	132	(2%)	5220	(89%)	638	(11%)	4897	(84%)	962	(16%)
	≥40 y.o	2329	(81%)	58	(19%)	2079	(87%)	308	(13%)	2018	(85%)	369	(15%)
Birth order	1st	4209	(97%)	116	(3%)	3728	(86%)	597	(14%)	3587	(83%)	738	(17%)
	2nd or later	4084	(98%)	72	(2%)	3777	(91%)	379	(9%)	3521	(85%)	636	(15%)
Birth weight	<2500 g	782	(97%)	26	(3%)	699	(86%)	110	(14%)	648	(80%)	161	(20%)
	≥2500 g	7378	(98%)	162	(2%)	6685	(89%)	854	(11%)	6362	(84%)	1178	(16%)
Gestational age	<37 wks	469	(97%)	16	(3%)	421	(87%)	64	(13%)	405	(84%)	80	(16%)
	≥37 wks	6943	(98%)	154	(2%)	6290	(89%)	806	(11%)	5954	(84%)	1143	(16%)
Birth abnormality	no	7639	(98%)	166	(2%)	6941	(89%)	864	(11%)	6566	(84%)	1240	(16%)
	yes	527	(96%)	22	(4%)	459	(84%)	90	(16%)	438	(80%)	111	(20%)
Father's smoking dp	no	4415	(98%)	80	(2%)	4047	(90%)	448	(10%)	3835	(85%)	660	(15%)
	yes	3541	(97%)	99	(3%)	3187	(88%)	452	(12%)	2992	(82%)	648	(18%)
Mother's smoking dp	no	7953	(98%)	175	(2%)	7216	(89%)	913	(11%)	6847	(84%)	1282	(16%)
	yes	321	(95%)	17	(5%)	276	(82%)	61	(18%)	249	(74%)	89	(26%)
Current father's smoking	no	4608	(98%)	88	(2%)	4214	(90%)	482	(10%)	4008	(85%)	688	(15%)
	yes	3095	(98%)	77	(2%)	2805	(89%)	366	(11%)	2611	(82%)	561	(18%)
Current mother's smoking	no	7400	(98%)	160	(2%)	6735	(89%)	825	(11%)	6401	(85%)	1159	(15%)
	yes	803	(97%)	29	(3%)	687	(83%)	144	(17%)	632	(76%)	200	(24%)
Someone to consult	no	8041	(98%)	170	(2%)	7300	(89%)	911	(11%)	6894	(84%)	1318	(16%)
	yes	184	(90%)	20	(10%)	149	(73%)	55	(27%)	162	(79%)	42	(21%)
Father's cooperation	no	7350	(98%)	155	(2%)	6716	(90%)	788	(10%)	6329	(84%)	1185	(16%)
	yes	400	(94%)	24	(6%)	350	(83%)	74	(17%)	340	(80%)	84	(20%)
TV viewing	<2 0h	3997	(98%)	79	(2%)	3710	(91%)	365	(9%)	3499	(86%)	577	(14%)
	≥2 hrs	4172	(97%)	115	(3%)	3691	(86%)	597	(14%)	3509	(82%)	779	(18%)

y.o, years old wks, weeks dp, during pregnancy (−), none (+), presence TV, television hrs, hours.

Table 3
Relationships between individual/environmental factors and each problematic behavior category.

	Anxious Behavior				Developmental Behavior				Personal Habits			
	Crude		Adjusted*		Crude		Adjusted*		Crude		Adjusted*	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual factors												
Sex (male)	0.95	0.72 1.27	0.94	0.66 1.34	1.86	1.62 2.13	1.83	1.54 2.18	1.11	0.98 1.24	1.06	0.92 1.22
Father's age (<40 y.o)	0.96	0.70 1.32	0.84	0.55 1.28	1.01	0.87 1.17	1.01	0.82 1.24	1.18	1.04 1.34	1.13	0.56 1.34
Mother's age (<40 y.o)	0.93	0.68 1.27	0.81	0.52 1.65	0.83	0.71 0.95	0.71	0.57 0.87	1.07	0.94 1.22	0.89	0.74 1.07
Birth order (first-born)	1.56	1.16 2.10	1.64	1.13 2.66	1.60	1.39 1.83	1.70	1.43 2.03	1.14	1.01 1.28	1.16	1.01 1.34
Birth weight (<2500 g)	1.51	0.99 2.30	1.26	0.98 2.34	1.23	0.99 1.53	1.01	0.73 1.41	1.34	1.12 1.61	1.35	1.04 1.74
Gestational age (<37 wks)	1.54	0.91 2.56	1.06	0.50 2.26	1.17	0.90 1.56	0.90	0.60 1.36	1.03	0.80 1.32	0.63	0.44 0.90
Birth abnormality (−)	0.52	0.33 0.82	0.41	0.24 0.71	0.64	0.50 0.80	0.71	0.52 0.90	0.75	0.60 0.98	0.73	0.55 0.95
Environmental factors												
Father smoking dp (−)	0.65	0.48 0.87	0.71	0.39 1.29	0.78	0.68 0.90	0.74	0.56 0.80	0.80	0.71 0.90	0.99	0.78 1.26
Mother smoking dp (−)	0.42	0.25 0.69	0.92	0.29 2.99	0.57	0.43 0.76	0.79	0.47 1.38	0.52	0.41 0.67	0.83	0.53 1.29
Current father smoking (−)	0.77	0.56 1.05	1.05	0.57 1.93	0.88	0.76 1.01	1.26	0.95 1.69	0.80	0.71 0.90	0.94	0.74 1.21
Current mother smoking (−)	0.60	0.40 0.90	1.02	0.46 2.24	0.58	0.48 0.71	0.67	0.46 0.95	0.57	0.48 0.68	0.65	0.78 0.88
Someone to consult (+)	0.19	0.12 0.32	0.21	0.12 0.42	0.34	0.25 0.46	0.34	0.21 0.51	0.74	0.52 1.04	0.76	0.48 1.22
Partner's cooperation (+)	0.35	0.23 0.55	0.61	0.27 1.35	0.56	0.42 0.72	0.72	0.47 1.10	0.76	0.59 0.97	1.04	0.68 1.57
TV watching (<2 hrs	0.72	0.54 0.96	0.63	0.47 0.99	0.61	0.53 0.70	0.74	0.62 0.88	0.74	0.66 0.84	0.78	0.68 0.90

y.o, years old, wks, weeks dp, during pregnancy TV, television hrs, hours The categories in parentheses in each factor indicate the group that the estimated OR is referring to. (−), none (+), presence
*Multiple logistic analysis was performed with all variables as explanatory variables.

CI, 0.62–0.88), and personal habits (OR, 0.78; 95% CI, 0.68–0.90). Mothers currently not smoking and having someone to consult about child rearing displayed a decreased risk for some types of problematic behavior. Mothers currently not smoking had an OR of 0.67 (95% CI, 0.46–0.95) for risk of developmental behavior and an OR of 0.65 (95% CI, 0.78–0.88) for risk of personal habits. Having someone to consult about child rearing had an OR of 0.21 (95% CI, 0.12–0.42) for risk of anxious behavior and an OR of 0.34 (95% CI, 0.21–0.51) for risk of developmental behavior.

3.3. Relationship between individual and environmental factors and each developmental behavior.

Many covariates showed significant associations with developmental behaviors; thus, we analyzed the associated types of developmental behaviors. Table 4 shows multivariate logistic regression analysis results for each type of developmental behaviors. Many covariates for individual factors (excluding father's age) were significantly associated with some types of developmental behavior. Males were at increased risk of violence (OR, 2.58; 95% CI, 1.38–4.79), restlessness (OR, 2.79; 95% CI, 2.19–3.55), and stereotypic behavior (OR, 3.51; 95% CI, 1.59–7.75). Birth order (firstborn child) showed an increased risk for all items of developmental behavior except violence; the risks included restlessness (OR, 1.95; 95% CI, 1.55–2.46), rebellious behavior (OR, 1.37; 95% CI, 1.02–1.83), restrictive diet (OR, 1.50; 95% CI, 1.10–2.17), and stereotypic behavior (OR 2.39; 95% CI, 1.16–4.95). Regarding environmental factors, the presence of someone to consult about child rearing showed decreased risks for all types of developmental behavior except violence; they included restlessness (OR, 0.35; 95% CI, 0.20–0.59), rebellious behavior (OR, 0.45; 95% CI, 0.22–0.91), restrictive diet (OR, 0.44; 95% CI, 0.20–0.97), and stereotypic behavior (OR, 0.23; 95% CI, 0.07–0.78). Mothers currently not smoking and having daily television-viewing time of under 2 h was significantly associated with decreased risk for some types of developmental behavior.

4. Discussion

In this study, we found that several individual and environmental factors were significantly associated with child problematic behaviors, such as anxious behaviors, developmental problems, and personal habits that caused concern for parents. Specially, birth order, and birth abnormalities were significant as individual factors; longer television-viewing time, mothers currently smoking, and lacking someone to consult about were significant as environmental factors. Those factors could reduce parental concerns about their child rearing.

Regarding individual factors, birth order (firstborn child) showed significant associations with all problematic behaviors. Furthermore, being first born was associated with many items of the developmental behaviors, such as restlessness and stereotypic behaviors. A possible explanation for this association is parental over concern for firstborn children owing to lack of experience. However, previous research has identified associations between birth order and child problematic behavior.

Table 4
Relationships between individual/environmental factors and each developmental behavior

	Violence		Restlessness		Rebellious Behavior		Selective Diet		Stereotypic Behaviors	
	Adjusted*		Adjusted*		Adjusted*		Adjusted*		Adjusted*	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual factors										
Sex (male)	2.58	1.38 4.79	2.79	2.19 3.55	1.28	0.96 1.70	1.04	0.75 1.44	3.51	1.59 7.75
Father's age (<40 y.o)	0.64	0.33 1.24	1.01	0.78 1.31	0.91	0.65 1.27	1.12	0.80 1.75	0.98	0.44 2.18
Mother's age (<40 y.o)	0.76	0.39 1.50	0.73	0.55 0.96	0.83	0.58 1.18	0.67	0.45 1.01	0.44	0.20 0.97
Birth order (first-born)	1.49	0.84 2.64	1.95	1.55 2.46	1.37	1.02 1.83	1.50	1.10 2.17	2.39	1.16 4.95
Birth weight (<2500 g)	0.34	0.09 1.31	1.36	0.92 2.02	0.83	0.46 1.47	1.02	0.53 1.97	0.56	0.13 2.50
Birth abnormality (−)	1.37	0.40 4.75	0.64	0.44 0.93	0.42	0.27 0.67	0.92	0.47 1.82	0.76	0.22 2.61
Environmental factors										
Father smoking dp (−)	0.48	0.19 1.20	0.80	0.55 1.15	0.80	0.50 1.28	0.71	0.42 1.22	3.03	0.88 10.5
Mother smoking dp (−)	0.47	0.14 1.60	0.72	0.38 1.34	0.95	0.42 2.14	0.69	0.25 1.88	0.78	0.08 7.93
Current father smoking (−)	1.22	0.49 3.01	1.19	0.82 1.73	1.23	0.76 1.99	1.14	0.67 1.97	0.61	0.18 2.08
Current mother smoking (−)	0.49	0.18 1.33	0.58	0.37 0.90	0.54	0.31 0.93	1.03	0.49 2.16	0.53	0.13 2.23
Someone to consult (+)	0.36	0.11 1.22	0.35	0.20 0.59	0.45	0.22 0.91	0.44	0.20 0.97	0.23	0.07 0.78
Partner's cooperation (+)	0.45	0.16 1.30	0.71	0.41 1.22	1.09	0.47 2.50	0.58	0.28 1.21	1.22	0.16 9.15
TV watching (<2 hrs)	0.91	0.51 1.60	0.81	0.65 1.01	0.62	0.46 0.83	0.55	0.39 0.78	1.32	0.67 2.58

y.o, years old, wks, weeks dp, during pregnancy TV, television hrs, hours The categories in parentheses in each factor indicate the group that the estimated OR is referring to. (−), none (+), presence
*Multiple logistic analysis was performed with all variables as explanatory variables.

Among 16,823 case-control studies that included family structure, Carballo et al. reported the risk of being diagnosed with developmental disorder or emotional disorder for firstborn children [16]. Tatsuta et al. reported that internalizing problems according to the Child Behavior Checklist (CBCL) was associated with parental child-rearing attitudes with respect to birth order [17]. Genetic or environmental factors, and parental rearing attitudes may be involved in the predominance of problematic behaviors among firstborn children; however, the reason remains unknown. The present study confirmed the findings of those previous reports and indicated that health providers should be mindful of the significance of birth order when supporting parents.

The second remarkable finding of the present study was that as an environmental factor, long television-viewing time (2 h or more) exerted an adverse effect for all types of problematic behaviors, including anxious behaviors, developmental behaviors, and personal habits. A similar result has previously been reported: watching television or playing video games for over 2 h a day was found to be positively associated with withdrawal, attention problems, externalizing problems, and total CBCL score [18–20]. The reason for this association also remains unknown. However, children with developmental disorders, such as attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder, are often exhausted after extensive television viewing or playing video games; that is thought to derived from an excessive reaction to the prefrontal reward system [21–23]. Otherwise, parents and children spending less time together owing to family structure, economic factors, and worktime could induce children to watch television for longer. Accordingly, those confounding factors could be associated with child problematic behavior. Our results would appear to underline the importance of parental awareness about their children's television-viewing time and the association with behavior.

Another important environmental factor toward preventing child problematic behaviors was the parents having someone to consult about their child rearing. Our results indicated the association between lack of someone to consult for child rearing and child problematic behavior, especially all types of developmental behavior (except violence). The meaning of someone to consult for child rearing has two aspects; support to parents by other peoples and support mothers by father's cooperation. Health providers giving support in child raising could relieve parental concerns about child rearing; that would reduce the degree of child problematic behavior. However, it has been reported that the rearing difficult children is likely to cause mental health problems among mothers [13]. It is believed that the mother's child rearing burden increases owing to child development problems. In Japan, the amount of child rearing burden tends to be much bigger for mother than that for father. Health providers need to be aware whether parents have someone to consult about child rearing.

Recent health promotional efforts have contributed to decline in smoking; however, this study found that about 10% and 4% of mothers, respectively, smoked during child rearing and pregnancy. This investigation also revealed that as an environmental factor, mothers currently smoking was associated with developmental behaviors. Thousands of chemicals including nicotine are known to be a psychoactive; they suppress neurological development of the fetus and affect child development, such as brain disorders [8,9]. Some studies have found that exposure to nicotine in the fetal period has a major effect from childhood to adulthood, such as causing academic decline, ADHD, behavioral disorder, and learning disability [10–12]. For optimal child development, health providers need to offer guidance against smoking in the child rearing period. Further, cognitive behavioral intervention is necessary for parents to discontinue smoking.

The present study has limitations. First, child problematic behaviors were not assessed by pediatricians or health examiners; it was based on subjective parental evaluation using a questionnaire. Thus, it is possible that parents who were anxious about child rearing overestimated their children's behavior. Second, we had no information about parents' annual income, final academic background, and family structure; they could have affected parental anxiety as confounding factors [24]. Third, long television-watching time was identified as an adverse effect for all types of problematic behaviors, however, we did not evaluate the effect of video game or YouTube videos, which are getting more popular for children. Furthermore, not only television-watching but also those other media-watching should be considered for children's problematic behaviors.

In conclusion, we found significant associations between children's problematic behavior and individual and environmental factors including birth order, birth abnormalities, long daily television-viewing time, lack of someone to consult about child rearing, and mothers currently smoking. In reducing the parental child rearing burden and supporting families who are raising children, health providers should be aware of those.

Conflicts of interest

The authors declare they have no conflict of interest with respect to this research study and paper.

References

[1] Nomura K, Koizumi A. Strategy against aging society with declining birthrate in Japan. Ind Health 2016;54:477–9.

[2] Barnrtt MA. Economic disadvantage in complex family systems: expansion of family stress models. Clin Child Fam Psychol Rev 2008;11:145–61.

[3] Conger RD, Donnellan MB. An interactionist perspective on the socioeconomic context of human development. Annu Rev Psychol 2007;58:175–99.

[4] Aarnoudse-Moens CS, Weisglas-Kuperus N, van Goudoever JB, Oosterlaan J. Meta-analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. Pediatrics 2009;124:717–28.

[5] Bhutta AT, Cleves MA, Casey PH, Cradock MM, Anand KJ. Cognitive and behavioral outcomes of school-aged children who were born preterm: a meta-analysis. JAMA 2002;288:728–37.

[6] Botting N, Powls A, Cooke RW, Marlow N. Attention deficit hyperactivity disorders and other psychiatric outcomes in very low birthweight children at 12 years. J Child Psychol Psychiatry 1997;38:931–41.

[7] Class QA, Rickert ME, Larsson H, Lichtenstein P, D'Onofrio BM. Fetal growth and psychiatric and socioeconomic problems: population-based sibling comparison. Br J Psychiatry 2014;205:355–61.

[8] Abbott LC, Winzer-Serhan UH. Smoking during pregnancy: lessons learned from epidemiological studies and experimental studies using animal models. Crit Rev Toxicol 2012;42:279–303.

[9] Blood-Siegfried J, Rende EK. The long-term effects of prenatal nicotine exposure on neurologic development. J Midwifery Womens Health 2010;55:143–52.

[10] El-Mohandes AA, Kiely M, Blake SM, Gantz MG, El-Khorazaty MN. An intervention to reduce environmental tobacco smoke exposure improves pregnancy outcomes. Pediatrics 2010;125:721–8.

[11] Linnet KM, Dalsgaard S, Obel C, Wisborg K, Henriksen TB, Rodriguez A, et al. Maternal lifestyle factors in pregnancy risk of attention deficit hyperactivity disorder and associated behaviors: review of the current evidence. Am J Psychiatry 2003;160:1028–40.

[12] Nguyen-Hoang P, Yeung R. From mother to child: the effects of prenatal maternal passive smoking on academic outcomes in the United States. J Public Health Policy 2018;39:231–44.

[13] Kingsbury AM, Clavarino A, Mamun A, Saiepour N, Najman JM. Does having a difficult child lead to poor maternal mental health?. Public Health 2017;146:46–55.

[14] Opondo C, Redshaw M, Savage-McGlynn E, Quigley MA. Father involvement in early child-rearing and behavioural outcomes in their pre-adolescent children: evidence from the ALSPAC UK birth cohort. BMJ Open 2016;6 e012034.

[15] Ishikawa M, Eto K, Haraikawa M, Sasaki K, Yamagata Z, Yokoyama T, et al. Multi-professional meetings on health checks and communication in providing nutritional guidance for infants and toddlers in Japan: a cross-sectional, national survey-based study. BMC Pediatr 2018;18:325.

[16] Carballo JJ, Garcia-Nieto R, Alvarez-Garcia R, Caro-Cañizares I, López-Castromán J, Muñoz-Lorenzo L, et al. Sibship size, birth order, family structure and childhood mental disorders. Soc Psychiatry Psychiatr Epidemiol 2013;48:1327–33.

[17] Tatsuya N, Nakai K, Murata K, Suzuki K, Iwai-Shimada M, Yaginuma-Sakurai K, et al. Parental exposures to environmental chemicals and birth order as risk factors for child behavior problems. Environ Res 2012;114:47–52.

[18] Cheng S, Maeda T, Yoichi S, Yamagata Z, Tomizawa K. Early television exposure and children's behavioral and social outcomes at age 30 months. J Epidemiol 2010;20:S482–9.

[19] Yousef S, Eapen V, Zoubeidi T, Mabrouk A. Behavioral correlation with television watching and videogame playing among children in the United Arab Emirates. Int J Psychiatry Clin Pract 2014;18:203–7.

[20] Yamada M, Sekine M, Tatsue T. Parental internet use and lifestyle factors as correlates of prolonged screen time of children in Japan: results from the super Shokuiku school project. J Epidemiol 2018;28:407–13.

[21] Han DH, Kim SM, Bae S, Renshaw PF, Anderson JS. Brain connectivity and psychiatric comorbidity in adolescents with Internet gaming disorder. Addict Biol 2017;22:802–12.

[22] Mazurek MO, Engelhardt CR. Video game use in boys with autism spectrum disorder, ADHD, or typical development. Pediatrics 2013;132:260–6.

[23] Weinstein AM. An update overview on brain imaging studies of internet gaming disorder. Front Psychiatry 2017;8:185.

[24] Hosokawa R, Katsura T. Effect of socioeconomic status on behavioral problems from preschool to early elementary school - A Japanese longitudinal study. PLoS ONE 2018;13 e0197961.